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Immobilisation of an Ammonia Tolerant Methanogenic Consortium in High Performance Anaerobic Digesters

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Introduction

Inhibition of the anaerobic digestion due to ammonia-rich residues is a common problem for the centralized biogas plants. Ammonia toxicity leads to decreased methane production and economic losses for the plants. The use of methanogenic consortia tolerant to ammonia toxicity could provide a sustainable solution for cost-effective digestion of less attractive ammonia-rich waste.

The aim of the current study was to immobilise an ammonia tolerant methanogenic consortium in a high performance anaerobic digester.

Experimental setup

An aceticlastic ammonia tolerant mesophilic (37±1°C) methanogenic consortium (**ATMC**), was immobilized in an up-flow anaerobic sludge blanket (UASB) biogas reactor ($\mathbf{R_{ATMC}}$, Fig. 1), working under high ammonia conditions (6 g NH_4^+-N L^{-1}).

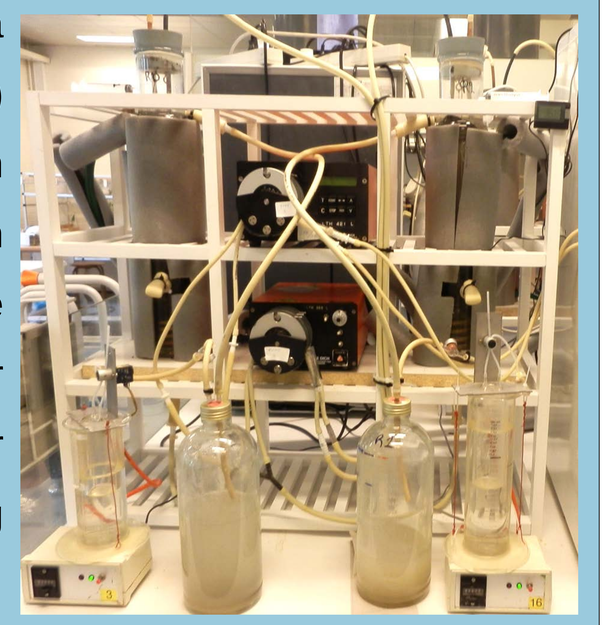

Figure 1. The UASB apparatus

Experimental setup

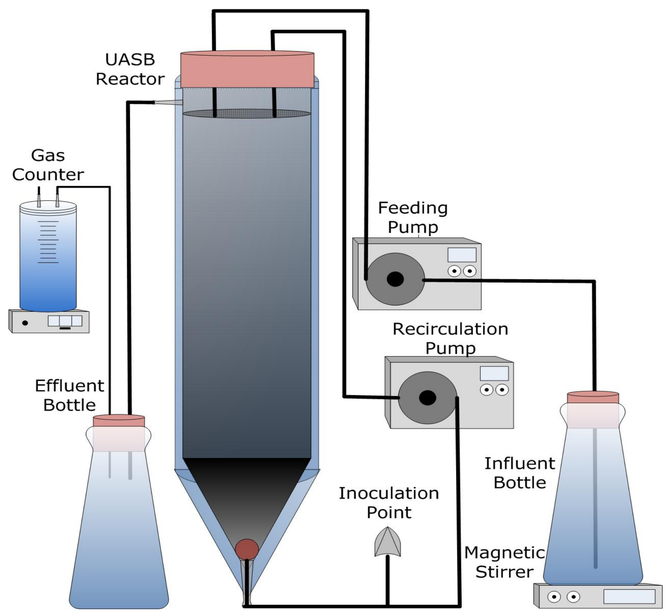

Figure 2. Reactors' set-up

ATMC has been enriched from inoculum derived from a mesophilic full scale biogas reactor (Hashøj, Denmark). A second reactor ($\mathbf{R_{control}}$, Fig. 1) without ATMC immobilisation, was used as a control reactor.

Experimental setup

Basal anaerobic (BA) medium was used as substrate and granules as carries. Glucose (4 g L^{-1} d^{-1}) and NH_4Cl, were used as carbon and ammonia sources, respectively. The working volume of the reactors was 1.4 L and the hydraulic retention time (HTR) 4 days (Fig. 2).

After the **immobilisation period** of AMTC (days 5–22), ammonia concentration increased to 7 g NH_4^+–N L^{-1} for both reactors.

Results

At 7 g NH_4^+-N L^{-1}, the UASB reactor with the immobilised consortium had up to 40% higher methane production rate compared to the ammonia inhibited control reactor (Fig. 3).

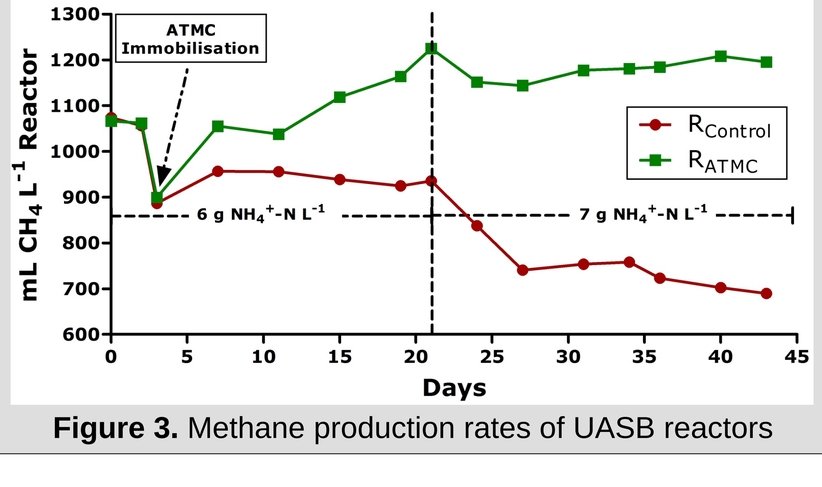

Figure 3. Methane production rates of UASB reactors

Conclusions

This study clearly demonstrated that **immobilization of ammonia tolerant methanogenic consortia** in high performance anaerobic digesters is a **promising solution** towards sustainable digestion of ammonia-rich residues.

Acknowledgments

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